Chapter 2

Mechanisms for MSEs to control environmental impact

Contents

The previous chapter characterized both the importance of MSEs in development and the range and severity of adverse environmental impacts that these enterprises can generate. This chapter focuses on two categories of approaches to mitigate these impacts: pollution control and cleaner production. The chapter closes by briefly describing environmental management systems, which enterprises of various sizes can use to regularly assess and mitigate their adverse environmental impacts.

Mitigation approaches

For each environmental impact, an MSE (and the organization assisting them) must find a strategy for controlling and/or mitigating that impact. The two main options applicable to any enterprise, including MSEs, are pollution control and cleaner production (CP). Pollution control is a strategy that can addresses a number of problems after they are created, while CP is an approach that examines and improves production processes to reduce pollution and other adverse environmental impacts before they are created. Importantly, CP can also have financial benefits to enterprises that implement it. These advantages typically indicated CP as the preferred mitigation approach, although it may not solve all environmental problems.

Pollution Control

Pollution control is a class of methods of controlling and/or capturing pollutants exiting a manufacturing facility before they can enter the environment to meet required pollution standards. Because pollution control approaches do not directly affect the way a business produces its products, and are added on to the production process, they are commonly referred to as "end-of-pipe" solutions. The most common pollution control approaches deal with air, water, and waste leaving an enterprise:

- Air pollution control technologies can include filters and other devices that remove contaminants from smoke or exhaust.
- Water control technologies typically use a variety of methods to remove impurities from the effluent (i.e., water leaving the premises).

Mitigation Approaches

Pollution Control:

Pollution control approaches are "end-of-pipe" solutions added on to the production process. These include:

- Air pollution control devices such as filters or scrubbers
- Water pollution control to remove impurities from discharged effluent
- Incinerators for solid waste reduction
- Hazard waste disposal site, such as a landfill specially designed to prevent leaching of pollutants into the environment

Pollution control does have problems, however:

- It represents an added cost to the business
- Need for oversight to ensure that MSEs install control equipment
- Need for technical training
- Does not address issues of unsustainable use of resources
- It cannot mitigate certain critical pollution problems, such as carbon dioxide emissions and global climate change
- It does not get rid of pollution permanently, but requires constant monitoring and management

- Incinerators can be used to decrease the volume of solid waste (trash) created by a facility, but will usually also require air pollution control technologies to minimize the release of contaminants into the air.
- Disposal techniques create a place for hazardous waste (including contaminants captured with other pollution control techniques) to more safely reside, in landfills or wells specially designed to prevent escape of contaminants into the environment.

For example, to meet government regulations on water pollution, a facility may install an effluent treatment plant and arrange their production processes to discharge all liquid wastes into the effluent treatment plant. Depending upon the type of effluent, contaminants, requirements, and ability to pay, the effluent treatment plant could use a variety of different methods to remove impurities. These include filtering, settling, stirring, and even evaporation. Impurities that are removed must be appropriately disposed, such as in a lined landfill, so that they don't just enter the environment via a different pathway -- such as being washed away in the rain. The effluent treatment plant is operated and monitored carefully by a worker who must be trained to ensure that effluent leaving the plant meets all requirements for levels of pollutants. The output from the plant may also be monitored by regulatory agencies to ensure compliance with legal levels.

Problems with pollution control.

Pollution control equipment was developed in the early days of environmental protection, when regulatory agencies first required companies to comply with pollution regulations. Such end-of-pipe devices can be effective at removing pollutants from waste streams, and may sometimes be the only way of mitigating and environmental problem, short of stopping the productive activity altogether. However, pollution control presents numerous disadvantages to both the businessperson and the environmentalist, particularly in regard to MSEs in developing countries. These include but are not limited to following:

- Pollution control typically only represents an added cost to businesses. In many assistance situations, it's conceivable that the cost of a pollution control mitigation technology may substantially outweigh the initial amount of assistance sought by the MSE. And, because pollution control strategies frequently offer economies of scale, MSEs are worse off than larger enterprises when they adopt it.[1]
- Because of the added cost, most MSEs typically will not install or operate pollution control devices without oversight.

[1] MSEs in some countries such as India have banded together to share the costs and technical expertise to operate effluent treatment plants, hoping to reap the benefits of economies of scale. However, such efforts have had mixed success and experienced numerous difficulties -- such as in transporting effluent to a central location cost-effectively and in ensuring fair play (Crow 1999). As such, it is difficult to recommend such strategies without extremely careful consideration.

- Many pollution control devices require technical training and sophisticated operation to work properly, which places an additional burden even on well-meaning MSEs.
- Pollution control will not address concerns about unsustainable use of resources, such as wood-burning that leads to deforestation.
- Pollution control cannot mitigate the critical pollution problem created by the release of carbon dioxide from burning fuel. Emissions of carbon dioxide are the main cause of global warming.
- Pollution control does not get rid of pollution permanently. Contaminants that are removed must be disposed of and monitored in proper facilities, which typically do not exist in developing countries.

In the face of these problems, businesses and environmentalists have over the 10-20 years developed an increasingly alternative sophisticated alternative mitigation approach: cleaner production.

Cleaner Production

Cleaner production (CP) is the preferred approach to mitigate adverse environmental impacts from MSEs. It represents a new way of thinking about success in business and environmental management. CP is...

- a **problem-solving strategy** that uses a collection of analytic tools to improve the **efficiency** of production processes and improve profitability and reduce risks to humans and the environment
- a **business-focused approach** that can be transparently integrated into a business planning process, and may boost creativity and innovation
- **relevant to all** sizes of enterprise, from home-based to multi-national

CP is also commonly referred to as pollution prevention (as opposed to pollution control), waste minimization, green production, and eco-efficiency.

Illustrations of CP Approaches & Benefits

Because it is easiest to gain an initial understanding of CP through illustrations of its application, we now present several success stories of CP implemented at MSEs. These examples have been chosen to illustrate the breadth of possibilities for CP among enterprises of different size, capacity, and manufacturing subsectors. As you read, pay attention to all the different kinds of CP approaches used by enterprises to improve their business environmental performance. These approaches will be detailed and classified in the subsection follows this one.

Mitigation Approaches

Cleaner Production:

Cleaner production (CP) is the preferred approach for MSEs. CP is:

- A problem-solving approach that improves the efficiency of resource use
- Business focused, and can be integrated in to MSE business practices and operations
- Relevant to all size of enterprises

Example 1: Cleaner Production in Soap Production[2]

Shivji and Sons Ltd., located in Dar es Salaam, Tanzania, manufactures laundry soap. The company has a production capacity of five tons of bar soap per hour and employs 45 permanent staff members and 20 seasonal workers.

A CP assessment revealed the following problems:

- The facility is powered by steam generated through combustion of diesel in boiler furnace burners. The company was wasting steam through leaky valves and inefficient use.
- Spilled fat during unloading of shipments to the factory resulted in loss of 3,000 kilos per annum. The spilled fat was absorbed by the soil.

By replacing leaking valves and traps, halving the fat storage tank heating time, adjusting water use to minimize steam consumption during cooling, and recovering the spilled fat, the plant was able to realize an **annual return on investment of US$185,700**. An initial investment of US$830 was needed for the installation of the steam valves; no input or energy costs were required for recovering the spilled fat. The payback time for this project was 2 days. Consumption of industrial diesel oil was **reduced by 54%, saving 415,800 liters per year** and reducing plant air emissions.

Example 2: Technology Change and Energy Efficiency in Cashew Nut Processing[3]

Three cashew nut processors in Ghana had problems with controlling the quality of their product. To process cashews, first the raw nut is steamed and shelled, then dried in industrial dryers. The shells of the cashew nuts are used as fuel for steaming, but the dryers are fueled by firewood harvested locally. Using firewood for fuel sometimes caused a problem for the businesses since the smell of the wood smoke would stay in the kernels, resulting in an unusable product. Also, it was difficult to regulate the temperature of the dryers using firewood. If the temperature were too hot, the kernels would burn, again resulting in waste product. Thus the businesses wanted to find a new source of fuel to run their dryers.

The government in Ghana was subsidizing propane gas tanks as a fuel source as part of a program to reduce deforestation. For two of the businesses, the subsidized gas was **less expensive** to use than the fuelwood. For the third business, however, fuel wood was essentially free since the staff harvested trees from on site. Nevertheless, all three businesses opted to switch to propane to run their dryers. The most important criteria for this decision were the ability to control temperature and smoke. **Reducing waste cashews** resulted in better profitability, even for the business whose fuel costs increased with propane.

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[2] UNIDO NCPC Case Studies, ICPIC

[3] TechnoServe/Ghana.

Example 3: Coffee Microenterprise in the Philippines[4]

To reduce wasted coffee grounds and water use, a microenterprise switched from using plastic pails to stainless steel bins to collect ground coffee particles. The ground coffee particles would stick to the plastic pails, requiring washing to remove. These particles did not adhere to the stainless steel, however, resulting in less lost product and better water usage. The steel bins were also more durable than the plastic pails, which required annual replacement.

The company **invested US$800** and realized an annual **return on investment of US$168** from recovering lost coffee grounds and avoiding the cost of replacing the plastic pails.

Example 4: Cleaner Production in Woodworking[5]

After being introduced to cleaner production, a small carpentry shop in Brazil devoted to producing furniture components for the local market took another look at its wood scrap waste. After some investigation the owner learned that the waste could be reprocessed into new 2-4 meter long boards using a process that cuts the scraps into triangles and then glues them together again (finger joint processing). After first outsourcing the work, the owner purchased a second hand finger joint machine that his employees operate during slower periods.

This example of waste-to-product CP required an initial **investment of US$180**, provided an **annual return on investment of US$6000**, and paid for itself in **10 days.**

CP strategies overview

As the examples above illustrate, CP opportunities can be identified through multiple approaches. These approaches can be arranged into nine categories, with many opportunities crossing the boundary between different categories.

1. Good housekeeping - Preventing leaks and spills, instituting preventive maintenance schedules, regularly checking equipment, making sure employees follow official work procedures. In Example 1, replacing leaky valves and traps represented good housekeeping.
2. Input substitution - Substituting one or more less expensive, less dangerous, or more efficient input for an existing input. Example 2's switch to propane fuel represents one type of input substitution, but replacement of input materials (such as chemicals) are also common.
3. Better process control - Changing working procedures, machine instructions, and process record keeping to increase throughput, reduce waste, and/or improve product quality. In Example 1, decreasing the storage tank heating time and optimizing water use for cooling both demonstrate better process control.

[4] GTZ. Applying Good Housekeeping in Food Processing. 2000.

[5] GTZ, Good Housekeeping Guide, 2000.

CP Approaches

There are nine areas where CP can help MSEs improve environmental and financial performance:

- Good Housekeeping
- Input/Resource substitution
- Better production process control
- Equipment modification
- Technology change
- Product modification
- Energy efficiency
- Recovery and reuse of materials
- Waste-to-product

4. Equipment modification - Changing the existing process equipment to increase throughput, reduce waste, and/or improve product quality. In Example 3, switching to stainless steel bins for collecting coffee particles was an equipment modification that reduced waste and improved profitability.
5. Technology change - Replacing the existing technology, changing the order of process steps to in to increase throughput, reduce waste, and/or improve product quality. Both the nut processors in Example 2 and the carpenter in Example 4 implemented new technologies to take advantage of a CP opportunity.
6. Product modification - Changing the characteristics of a product to increase throughput, reduce waste, and/or improve product quality. For instance, joining the parts of a product together with bolts instead of glue may improve product durability and reparability.
7. Energy efficiency - Making changes in any aspect of business operations to reduce energy consumption or cost. The soap producers in Example 1 increased energy efficiency by optimizing heating and cooling needs, while the nut processors in Example 2 increased energy efficiency by switching fuels.
8. On-site recovery and reuse - Capturing and reusing onsite materials that were previously wasted. For instance, Example 1's soap producers captured previously wasted fats.
9. Waste-to-Product - Identifying an end market and marketing a material formally considered waste. May involve changes in processing of original product or new processing steps to transform waste. In Example 4, the small carpentry operation created a new, profitable product from its formerly unused wood waste.

Why is CP the Preferred Mitigation Strategy for MSEs?

Better environmental management translates to better overall management. Pollution can be thought of as non-product output, material that the enterprise has paid for but for which it will receive no revenue in return. Controlling pollution at the “end of the pipe” requires an additional expenditure beyond the cost of the non-product output. This cost burden is difficult for MSEs to meet, as resources are limited and investment priorities are numerous. Cleaner production is more suitable than Pollution Control technologies in a MSE context, because the benefits are more aligned with the realities of their competitive environment. Specific benefits include:

Flexibility. CP can be applied to any size business, from microenterprise to transnational corporation. Because it is a business-focused, profit-driven approach to pollution management, CP can be integrated transparently into a business planning process.

Environmental Benefits. CP can reduce both pollution output and demand for natural resources (water, energy, raw materials, etc) as production inputs. By minimizing fuel use, CP can help reduce the emissions of greenhouse gases like carbon dioxide, which contribute to global warming. By reducing the need for chemicals and other inputs, CP helps reduce environmental damage by suppliers. CP also reduces the need to rely upon technically sophisticated disposal methods to protect the environment.

Health & Safety Benefits. Typically, MSEs can mitigate their primary health and safety problems at low cost, with associated improvements in worker productivity. Threats to worker health and safety can be sources of poor quality products. For example, in the food-processing sector, products can be contaminated and/or workers harmed by incorrectly handled hazardous chemicals, pesticides, broken glass, scrap metals, and trash. CP can help find alternatives to chemicals and pesticides, as well as identify sources of glass, metal, and trash which can be controlled through housekeeping or proper management. CP approaches can also help improve working conditions, which reduces the risk of accidents. For example, to reduce energy costs, a CP improvement might be to improve natural lighting by painting the production area white and regularly cleaning windows. This type of improvement not only saves money by reducing the need for artificial lighting, but also reduces employee eye-strain, preventing mistakes and injuries.

Financial Benefits. CP can increase profitability by reducing upfront costs of input materials and energy, and reducing costs for non-product outputs and waste disposal. Using CP, an enterprise can also improve product quality, increase throughput, and avoid regulatory and compliance costs. Additionally, many CP improvements require little or no initial investment and offer rapid payback opportunities. Simple management techniques such as instituting a "First In, First Out" approach to stored perishable goods can reduce loss due to spoilage. Good housekeeping procedures such as keeping the workspace free from obstructions can reduce the likelihood of accidents and spills. Low cost improvements, like replacing leaky values or recalibrating thermometers and pressure gauges, can provide rapid payback on investment and involve minimal interruption of production schedules.

Risk Reduction. CP can help reduce reliance on different kinds of inputs, minimizing the risk of supply chain disruptions. For example, using renewable energy sources might be appealing because of the opportunity to avoid unreliable electricity supplies. Honing water conservation techniques may help businesses to survive during periods of drought.

Marketing Opportunities. CP can help an enterprise establish new product lines or access new markets. In the above case study of the Brazilian carpenter, he was able to establish a complete new, profitable product line by applying the CP Waste-to-Product strategy. CP skills can help achieve HACCP[6] certification, allowing food-processing enterprises to access the export markets of Europe and the United States. CP also improves company image to communities and environmentally conscious customers, and may allow enterprises to access niche markets.

Management Enhancements. CP can improve a business' management by:

- *Building decision-skills*. The CP process identifies poor or inadequate accounting practices, allowing for better, more consistent oversight of risk, short-term cash flow, and product quality.

CP: The Preferred Mitigation Strategy for MSEs

MSEs can benefit both financially and managerially from the introduction of CP into their operations. These include:

- Flexibility in applying to different sized businesses
- Environmental benefits from reduction of natural resource use and lower carbon dioxide emissions
- Health and safety benefits for workers that improve productivity
- Financial benefits, from lower costs for materials and more efficient use of resources
- Risk reduction
- New marketing opportunities
- Enhancing the management skills

[6] HACCP stands for Hazards Analysis Critical Control Points. It is a strategy for managing and guaranteeing the safety of food processing systems.

- *Improving management competence*. Similar to Total Quality Management, cleaner production builds quality and efficiency into products, rather than repairing defects.

- *Enhancing profitability and competitiveness in the long run*. Improved management and quality, combined with cost savings, lays a solid foundation for economic sustainability of the enterprise (and repayment of any loans).

Recognizing these advantages, a major European bank, UBS, has begun to screen all loan applicants for energy efficiency and good resource management. UBS focuses on operational cost indicators that "reflect efficiency in financial terms."7

Overcoming Challenges to Adoption of CP by MSEs

Of course, implementing even the most enticing CP opportunity and reaping its benefits may be challenging for any enterprise, but particularly for MSEs. For instance, in India, a project working with 12 small-scale enterprises in the textile, pulp and paper, and pesticides industries identified approximately 450 different cleaner production options.[8] At the same time, however, the project identified several kinds of barriers that inhibited CP adoption, which can be grouped into four categories: systemic barriers, technical barriers, economic barriers, and attitudinal barriers. Understanding those barriers was critical to project implementers in assisting the enterprises in moving forward to implement over 46% of the cleaner production opportunities with in a 15-month timeframe -- all of which had a payback of less than six months.

Such barriers can sometimes seem daunting, but BDS and credit providers already provide services that counter these barriers. The challenges that BDS and credit organizations might encounter in promoting CP are very similar to challenges encountered in promoting any new way of doing business, and may be less formidable than those challenges encountered in implementing pollution control mitigation strategies. The table below presents the kinds of barriers encountered in Project DESIRE and CP projects everywhere, and also gives suggestions for dealing with them -- although it is expected that readers are experienced in overcoming such barriers in their own work.

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[7] Hugenschmidt et al. 1999.

[8] Information on Project DESIRE outcomes adapted from Chandak 1994 and Pallen 1996.

Barrier Type	Barrier Examples	Suggested Approaches to Overcoming Barriers
Systemic	• Poor record keeping and reporting • Ineffective management systems • Ad hoc production planning • High staff turnover • Seasonal variations, making high efficiency difficult	• Business planning assistance and advising • Management capacity building • Technical assistance to improve record keeping and reporting capacity
Technical	• Limited general technical ability • Limited access to technical information/success stories • Limited maintenance capabilities	• Technical assistance • Networking with successful CP implementers • Focus on least technical CP approaches
Economic	• Lack of financing for CP • Preference for least capital-intensive option even if not best option • Poor investment planning, leading to partial implementation	• Facilitate financing for CP • Provide training in investment planning
Attitudinal	• Lack of good housekeeping culture • Resistance to change • Risk aversion/fear of failure • Lack of employee input in decision-making	• Leadership training • Technical assistance • Management capacity building • Employee training

Environmental Management Systems

Until now, this chapter has focused upon approaches to help MSEs mitigate environmental problems at a particular point in time. However, proper management of environmental responsibilities can require frequent attention. How can MSEs continue to mitigate both existing and new adverse environmental impacts over time? An MSE can do so by implementing and operating an environmental management system (EMS). An EMS is a formal system that an enterprise of any size can use to help it to *regularly* identify and assess environmental problems (and opportunities), develop and implement solutions and monitor the results.

The most widely known environmental management system is ISO 14001, which is a complicated management system typically implemented only by medium and large enterprises (see box). Readers should recognize that ISO 14001 is unlikely to be relevant and useful to MSEs they work with. However, this does not mean that MSEs cannot utilize or implement an EMS. For an MSE, the paperwork and formal allocation of environmental responsibilities of a standardized EMS is probably unnecessary. Rather, much can be accomplished if the MSE will commit to monitoring its mitigation approaches, and regularly reassessing the situation, on a schedule that suits the MSE. This might be as simple as reviewing CP approaches once a year, during a seasonal lull in business, to identify new opportunities. (Research has shown that CP opportunities, like fruit, grow back.) A primary goal of an EMS is that it lead to continual improvement and each individual enterprise must determine the appropriate mechanisms to accomplish that.

ISO 14001: The EMS Standard

ISO 14001 is the most common EMS in the world today, having been adopted by thousands of businesses worldwide. The certifiable standard has detailed requirements for the following components of an environmental management system: policy, planning, implementation and operation, checking and corrective action, and management review.

Because setting up, operating and becoming officially certified as ISO 14001 compliant can represent a substantial investment, the vast majority of certified companies are large and medium enterprises. Furthermore, firms in the electronics and automotive sectors are the predominant ISO 14001 companies, because certification to ISO has been required by major purchasers, such as GM and Ford. The benefits of certifying to ISO 14001 are dubious for an MSE, unless doing so will allow access to a lucrative market opportunity that the MSE would otherwise be well placed to take advantage of -- such as becoming a supplier for GM.

Readers should also recognize that ISO 14001 certification does not provide a clear indicator that accompany has good environmental performance. It only indicates that the company has properly implemented the ISO 14001 environmental management system -- which does not specify any particular performance levels. There is currently a lack of evidence indicating that ISO 14001 companies have better environmental performance than similar companies that have not implemented ISO 14001.